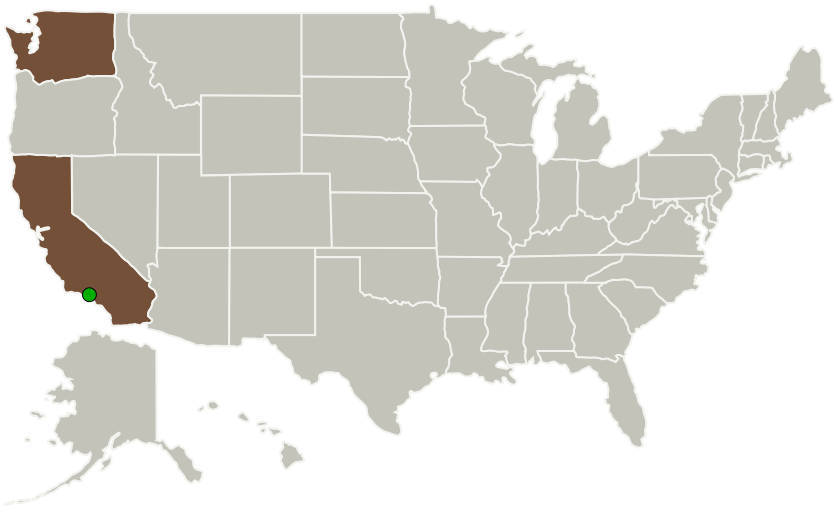
Long Life Cathode Heaters for Hollow Cathodes, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

Present and future NASA missions, including the Asteroid Redirect Mission and efficient cargo delivery to mars, require a substantial increase in lifetime for ion engines and Hall thrusters. This has led to the development of long-life lanthanum hexaboride (LaB6) hollow cathode emitters, which operate at temperatures >1600ºC. Current state-of-the-art co-axial swaged cathode heaters use magnesium oxide (MgO) insulators, which experience a significant drop in insulation resistance at temperatures of 1300ºC, causing heater failure. Hollow cathode failure caused by the failure of an external cathode heater is the single most critical event that controls the thruster lifetime. While alumina (Al2O3) has recently been used as a replacement insulator material, it has questionable reliability due to grain growth and void formation at temperatures >1600ºC. In Phase I, we will formulate a new ceramic insulator using sound scientific principles, and develop a long-life cathode heater that can operate reliably at high power levels (>200 W) at high temperatures greater than 1600ºC for use in long duration space propulsion missions. We will design, fabricate and test prototype swaged coaxial heaters to demonstrate the superior performance of the new insulators.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Sienna Technologies, Inc.	Lead Organization	Industry	Woodinville, Washington
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Washington

Project Transitions

June 2016: Project Start

December 2016: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139903)*

Images

Briefing Chart Image
Long Life Cathode Heaters for Hollow Cathodes, Phase I
(https://techport.nasa.gov/image/131642)

Final Summary Chart Image
Long Life Cathode Heaters for Hollow Cathodes, Phase I Project Image
(https://techport.nasa.gov/image/133047)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Sienna Technologies, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

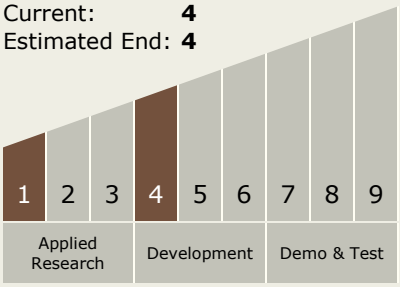
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Ashley L Bissell

Technology Maturity (TRL)

Start: **1**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System